Survey on Development of Fingerprint Biometric Attendance Management System using Wireless Connectivity

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Abstract - *In the modern era, various organizations, institutions and companies are keeping track of employees/staffs attendance using the biometric fingerprint authentication system. Attendance management is an important and herculean task. Along with this, the institutions with a single device tend to accumulate crowd and becomes a clumsy and chaotic task. In the biometric fingerprint authentication system, the system keeps track of employee attendance avoiding fake entries. But the question arises about the complete presence of the employee/staff during the working hours after he/she has punched in the attendance for the day. It has been usually noticed that the workers tend to escape their workplace after giving the attendance at the right time. In this paper, we focus on proposing a smart attendance management system which has the integration of both concepts- biometric fingerprint system and wireless connectivity for a particular restricted area. We mainly encompass the idea of using an android mobile phone device as a smart ID card for which we develop a mobile application in Java. The system will register the user and accept the attendance of the employee through the use of this smart ID card, with all the records being saved for subsequent operations in the backend using database. The system provides portability since the input image is accepted using a mobile device and reduces need for external fingerprint scanning device which also reduces the hardware cost and maintenance.*

Key Words: **Smart ID card(android mobile phone), android application, fingerprint authentication, wireless LAN, smart attendance management system**.

1. INTRODUCTION

Biometric Identification acts as a unique ID proof for any individual. Recently Biometric Identification has become popular due to its uniqueness, consistency and specificity. Biometric authentication is the process of analyzing the data for the person's characteristics to that person's biometric template to determine resemblance. This technique cannot be duplicated and it is highly secured. The main goal of applying biometrics to user authentication is to provide security to users and detect imposters in terms of user's physiological or behavioral characteristics.

Approximately there exist about 14 types of biometric technologies which are DNA, Iris, Retina, face, fingerprint, finger geometry, hand geometry, odor, typing, vein , voice, and gait recognition. These are all techniques of identifying and authenticating individuals that would provide a more reliable and efficient way of verifying a person identification also preventing access to unauthorized personnel.

Fingerprint based biometric authentication and verification systems have gained enormous demand in the market. As it is easy to operate install, alter and easy recovery of fingerprint. Achieving fingerprint recognition system as secure to use since the uniqueness of a fingerprint does not change in a lifetime. Different organizations use Biometric fingerprint authentication to identify their employees. It diminishes the proxy giving attitude of the employees. To identify the employee, the fingerprint sensors are generally set up in front of the entrance or exit door. Sometimes, some employee misuses the advantage of this fingerprint sensor. An employee uses his own fingerprint to open the door for someone else to leave. So, the fingerprint sensor can't ensure the presence of an employee in the workplace. [1]. To avoid the misuse of the hardware we can come up with an easy going, cost efficient approach. There is a cumulative progress of android technology and its availability over a decade. Android application has made life easier and convenient. Here android technology plays an important role. In recent years, mobile phones have become one of the popular gadgets. So, we have developed a fusion of wireless network and fingerprint authentication system as a mobile application.

Only a mobile application cannot ensure the presence of an employee in an organization. To ensure their physical presence not only a mobile application is required but the organization should be linked with a router. Here the android phone acts as a smart card to all the employees of an organization.

An employee can be able to give his attendance only if he is connected to that specific router. This ensures the physical presence of an employee. A counter will be there in the system which will calculate the time of being present in the workplace as long as someone is connected to the router. When an employee leaves, the device will get disconnected and as soon as it comes into the range of the router it will be reconnected again and resume the counting process where it was left. The whole system is a fusion of fingerprint authentication system and wireless router where the attendance will be started counting only after an employee is in the router range and gets logged in through fingerprint authentication at the same time. This is a session based log-in system which will randomly get signed out at any time of the working hour and needs the employee to get logged in again through fingerprint authentication within a given time to resume the attendance process. The log in process is session based so that an employee cannot leave the place without the device. [2]

Our proposed system can set aside the traditional attendance system as it has many advantages such as high accuracy; optimize time complexity and router system. Some characteristics of the proposal system are:

1) Dependency on biometric hardware is reduced.
2) Due to reduced dependency, cost of the system as whole is reduced.
3) Provides increased portability to system.

2. LITERATURE SURVEY

In the present hi-tech world, there is an ever growing need to authenticate and identify people for security purposes. A wide variety of modern systems requires consistent personal recognition schemes to either confirm or determine the identity of an individual requesting their services. The objective is to ensure that the rendered services are accessed only by a legitimate user and no one else, to discourage fraud and enhance security and to specifically identify individuals in corporate areas. Person identification methods are generally classified into three categories namely, a) Knowledge-based approach: Person who knows something to make his/her personal identity such as password or personal identification number (PIN). b) Token based approach: It uses particular ID, such as a passport, keys, ID card. c) Biometric based approach: This approach uses physiological or behavioral features of an individual which cannot be stolen or lost. The biometric identification method consists of three operations, they firstly capture biometric sample of the person and make a digital representation of the sample, then extract unique features from the digital representation using feature extractor, and then compare the extracted feature set against the template set in the database via matcher.[3]

The manual attendance tracking system for any system is a very tedious and cumbersome process. It consumes a lot of time. Our advanced attendance system will help to get rid of this problem. In this section we have briefly discussed those works which are related to automating the attendance system.

Some studies have been found that especially focused on the attendance system using biometric fingerprint authentication. J.Chandramohan et al. [5] discussed the system which was basically a micro-controller based prototype which used fingerprint sensor and in order to track individual missing person's location it used GSM technology. They only dealt with biometric authentication using micro-controller which is a hardware concept.A study conducted by Jennifer C et al. [6] introduced an advance attendance system. It was basically an Arduino based system which combined with MATLAB. They developed a fingerprint identification system using Adafruit Fingerprint algorithm with the help of Arduino. To detect and recognize the face, they used Viola-Jones Face Detection Method and Principal Component Analysis (PCA) with the help of MATLAB.

Sarkar et al. [7] designed and implemented smart Attendance system using multiple steps. They focused on to overcome the inconveniences due to manual attendance system by using radio frequency identification, biometric fingerprint sensor, and password based technologies. They developed a C based desktop application to monitor the attendance system which gives a better solution because they developed a software application. Adeoye Temitope Onaolamipo [8] adopted a biometric access control techniques. A system was designed with an extended graphical user interface by using Microsoft visual studio 2010 and merged with Microsoft fingerprint reader. In the users computer or server, the student information was stored on the server with the help of MySQL. Parul Wadhwa [9] focused on an android application. She developed a system where a student could give their attendance with the help of a fingerprint sensor and later on the data would be stored in a centralized database. An Android application would use this database and from that application, students would be able to view their attendance. Another study has been conducted where Akshay A. Kumbhar et al. [10] focused on storing the attendance information in an Attendance Monitoring System (AMS) using the Android platform. The system consisted of two apk files, one was for the teacher and another was for the students. Just with the help of a click, students would able to give their class attendance and just with the help of a click, the teacher would generate a report of all the students.

There are some studies which focus on the wireless network. A study conducted by Sharma and Jain [11] where they introduced a system where they used only a

smartphone to identify a person's location with the help of Global Positioning System (GPS), Wireless Fidelity (Wi-Fi) and Network signals. In another study, Shermin st al. [12] included a location-based time and attendance system where employees used an android application. When an employee has entered his workplace area, the system connects to the office internet and sent the employee id and local time to the server. Then the server stores the information in the database. When the employee leaves the system, a notification would be generated by the system. In sum, most of the system introduced a different kind of methods to eliminate the manual attendance system so that the working time is optimized. But some of them considered a hardware approach which will create a queue in front of the device which will be another reason for wasting the working time. Few others consider this factor but again end up with a desktop application which means the solution is not handy and available to everyone. Others have implemented an android application which is handy but again cannot able to track after giving attendance employees still remain in their work place. This study will dwindle this research gap to some extent by introducing a system which will keep track of an employee with time intervals.[13]

3. SYSTEM IMPLEMENTATION

3.1: Data Capturing:-

The authentication of fingerprint is usually not done with extreme care when placed during the process of registration and this result in rejection. Fingerprint is been done in their respective android phone where their fingerprint is been taken once they enter within the router area it connects to the wireless network and fingerprint of the individual is asked to consider once attendance. When they are out of range of the router it automatically disconnected from wireless and the employee logout.

3.2: Decision Making:-

The template stored in the database is compared with the fingerprint image. If the fingerprint matches the template then attendance of the user will be marked. If the fingerprint is not the same then it will not be considered. The system is created using java programming for the front end and sqlYog database for storage on backend. It involves the interaction with the server database containing all information of the staff. The records provide details of attendance.

3.3: Enrolment Phase:-

This phase involves registration of user. The process of registration is important in order to identify each user

uniquely. All of the staff members are required to enter certain personal information like staff fingerprint, names, phone number, email address, sex, occupation, state of origin, house address, as well as academic information like staff id, department, and designation. The registered information is then stored in database.

3.4: Identification Phase:-

The identification is accomplished by comparing the input image with stored template in the database. If both the fingerprints are matched, then it is considered as a positive match.

3.5: Attendance Report:-

The report can be found under the report menu, where daily attendance of all staff can be generated according to employee id. The attendance of every staff member is stored on the server database. Thus the system allows the database admin to view the attendance report based on daily basis and also employee's monthly attendance.
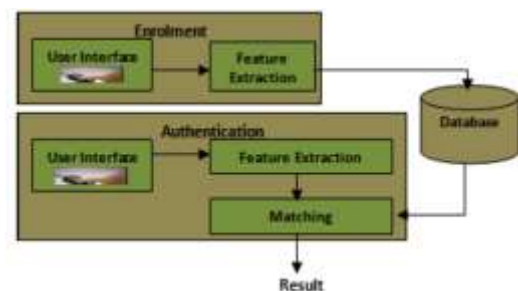

Fig -1: System Implementation

4. Design of Proposed Architecture

In this section, we will be discussing the system design. There are two processes 1. Finding the importance of the system, 2. Developing a conceptual design.

4.1 Finding the Importance:-

This system can take over the traditional attendance system through fingerprint authentication. To find the need of this system, we have collected notes from our college institute and asked them questions regarding the traditional Biometric attendance system as to how they feel and what are the changes they wish to see. We noticed a number of disadvantages and needs:

- The traditional fingerprint attendance system consumes a lot of time to take attendance accurately.

- There is often a queue in the front of the gate where the biometric hardware is installed.
- The hardware maintenance is cumbersome and tedious. When there is some problem with these sensors then the whole of the system collapses and the organization needs to maintain attendance in a manual format until the hardware sensors are up and working.
- One common thing and the biggest disadvantage that we noticed was that the employee leaves the workplace once he/she has punched in their attendance for the day. This is a huge loss for the organization.

Our guide has also agreed for the need of efficient and accurate attendance management system.

4.2 Developing the conceptual design:-

Here we state the conceptual design which is a block-diagrammatic representation of the system proposed. Figure-2 depicts the block diagram of proposed architecture.

One of the major factors of our proposed system is User authentication. To ensure authenticity of the user we use their fingerprint. Bio-metric fingerprint helps in uniquely representing and identifying a person. Fingerprint authentication will ensure the physical presence of an employee inside the working place. Initially, in the beginning the employee will have to install the relevant APK files on their android mobile phones which act as a smart id card.

This step is followed by the registration of the employee on the system with his fingerprint and his details like name, employee id, designation, phone number etc. The system does not allow duplicate entries to prevent redundancy and duplication of data. Thereafter, that employee's mobile phone is registered on this system through the corresponding MAC address.

The android application will fetch the MAC address from the device and send it to the server. There is a counter used that gets initialized before the starting of the working hours and it will continue to count till the working hours end. To ensure the presence of that employee, he has to give his fingerprint with the help of his android mobile phone which is allowed after he is in the range of the router. Once connected, the counter in the system will get initialized and starts counting the time period for which the device is connected to the router.
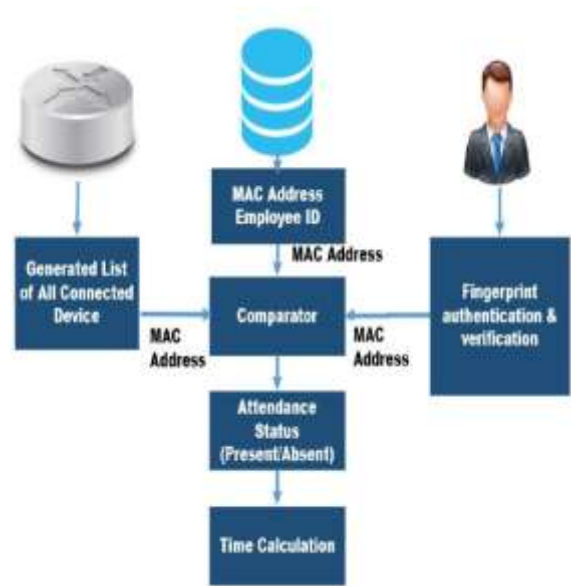

Fig -2: **Block Diagram of the Proposed System**

The organization is able to see the devices through the admin login portal thereby implying the presence of those respective employees. This system is a session-based log-in system meaning that , if an employee is working for 8 hours in the organization, his mobile would log out of the system randomly for say 3/4th times during the day which pauses the counter. The system asks the employee to log-in again within some limited amount of time, failing which, the system would interpret the employee's absence from the institute. If he logs in back within the given time limit by giving the fingerprint, the counter resumes. At the end of the day, the system shows the total number of hours that the corresponding device was connected to the router.

The flow chart for the session based login is shown in Figure-3.

At the end of the working time, the status column of each employee will show the attendance of every employee. The attendance will be sent to the server. This attendance will be automatically updated into the profile of each employee.
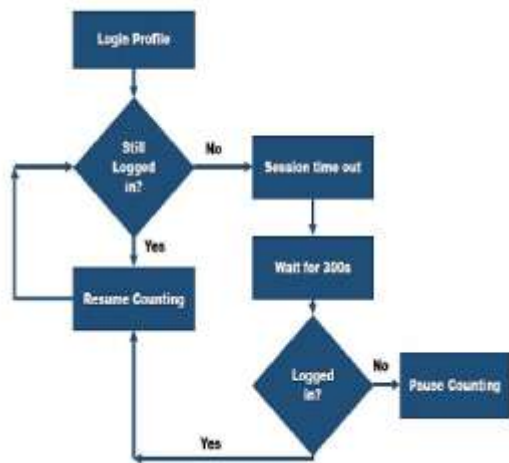
Fig-3: The flowchart of session-based login

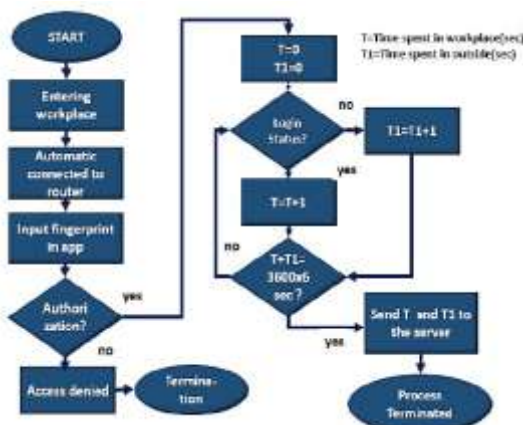The flowchart of the system is given in Figure- 4.

Fig-4: The flowchart of the system

The summary of the process is shown in a table below:

Is the device in WIFI range?	Fingerprint Authenticated?	Account Status
No	No	Logged Out
No	Yes	Logged Out
Yes	No	Logged Out
Yes	Yes	Logged In

5. Development of Proposed Architecture

5.1: User Interface:-

The layout of the user interface is done by extensive markup language (XML). XML is mainly created to store and transport data. XML is self-descriptive. XML is derived from Standard Generalized Markup Language (SGML) and a text based markup language. We used the android platform to develop the whole development system in Android Studio. We have also used Java for the development purpose which is the official language of Android development and is well supported by Android Studio.

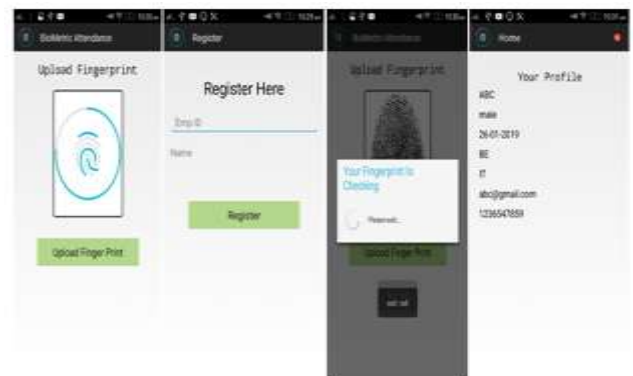The figure-5 below depicts the UI design of our mobile application:

Fig-5: The UI design of our mobile application.

5.2: Database:-

We have used MySQL database, MySQL is a database system, used for developing web-based software applications. MySQL is a relational database management system *(RDBMS).* MySQL supports standard SQL *(Structured Query Language).* After registration of the employees into the system, their identity is followed by a unique key in MySQL server and we considered that as MAC ADDRESS. In the MySQL server, several rows have been allocated for every employee's where they have features like name, employee ID, device's MAC ADDRESS, Fingerprint sample etc.[14]

5.3: MAC Address Access:-

The MAC Addresses of the devices are kept in the same. MySQL server where attendance procedure is authorized depending upon whether it is matched of the employee on the same server. Information about the amount of time a device is connected to the router shows the time he is in the company .Is retrieved from the WNetWatcher software and sent to the server for further process.

5.4: Server:-

We have used JDBC to connect the MySQL database server to the Android studio. Java server pages is a server side technology that does all the processing at server.

5.5: Session Based Log In:-

Session-based log in is handled using random number generator in Java which is kept random for the development purpose of the system. [15]

5.6: Android Based Mobile Application:-

Android provides robust security at the OS level through the Linux kernel. It is mandatory application sandbox for all applications. It also provides secure interprocess communication. Application framework is used higher-level services to applications. The development of the proposed app is done in such a way that it files permission and access to the admin and system permission at any type of situation about any security issues.
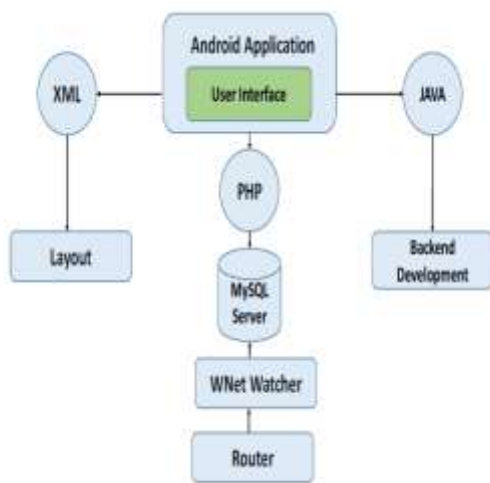

Fig-5: Development of Proposed Architecture

6. Evaluation

It is assured that this system has the following benefits:
>>Accuracy: This system can accurately take the attendance of the employees as it is fingerprint-based and no one can give the proxy of others.

>>Time Consuming: This system reduces the time of taking attendance as the employees only need to give the fingerprint through the mobile phone.

>>Maximizing number of employees in the working place: As the mobile phones of the employees need to be

connected to the router, it counts the time they remain present in the working place. As a result, the employees barely leave the working place.

Thus the system has advantages which make it separate from the existing attendance taking method. The difference between this method and the existing method are given in Table II.

Table-II: Difference between the existing and the proposed system.

Existing System	*Proposed System*
1. Most of the existing attendance taking systems are only fingerprint based.	1. This attendance taking system consists of fingerprint and wireless network (router).
2. The existing fingerprint system is usually placed in front of the working place or at the entrance of the institution, so it can only detect if an employee has entered into the working place but it cannot detect whether an employee tries to escape from the working place or not.	2. This system has a router which counts the amount of time an employee spends in the workplace.
3. An employee can leave the work place after giving the attendance through this system.	3. An employee has to remain in the workplace because the system counts the amount of time the device is connected to the router. So he chooses not to leave the place.
4. In existing systems, an employee can let others enter and leave using his fingerprint.	4. In our proposed system it is not possible.

7. CONCLUSION

The proposed has been developed by observing the existing system. This system automates the existing system. It provides higher level security compared to that of the existing system but also is cost efficient as the mobile phone acts a smart card. Due to the phone acting as

the smart card employees going out company is reduced which leads to

efficiency of the employees which leads to progress of the organization.

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BIOGRAPHIES

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